Environment, Electricity, and Natural Gas Demand

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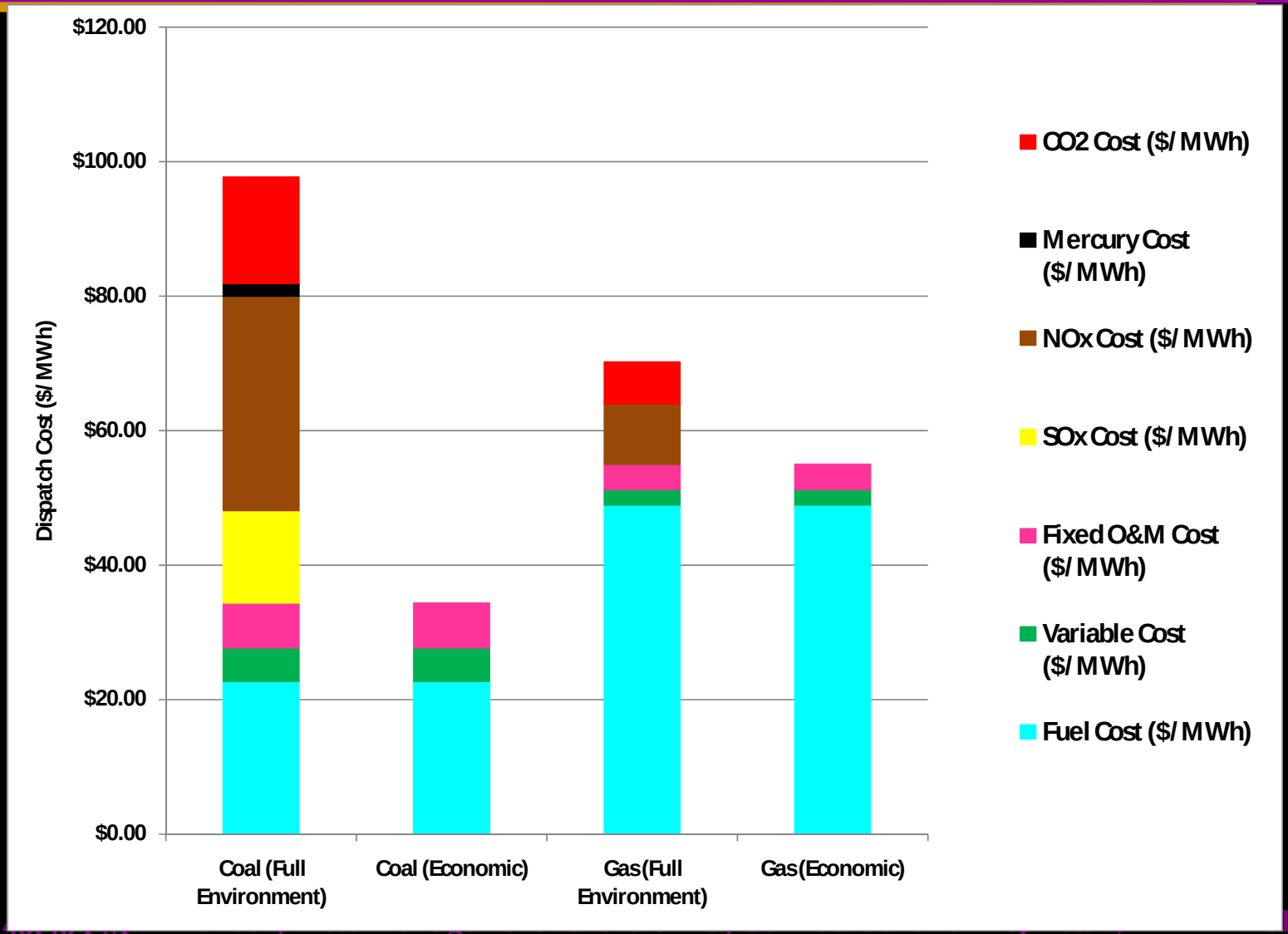
Environment Is the 500 Pound Gorilla Coming to the Fore

- We already today or soon in the future will trade or tax
  - ✓ SO2
  - ✓ NOx
  - ✓ Hg
  - ✓ CO2
  - ✓ Particulates
- These policies are differentially deleterious to coal
  - ✓ Existing coal plants are about to decrease baseload run time
  - ✓ New coal plants are risky and will not be built
- Existing and new regs are de facto a direct subsidy to renewables, natural gas, and arguably nuclear.
- High renewables scenarios are high, not low, gas burn scenarios.

Gas Burn for Power Generation

- Is extremely sensitive to ALL environmental caps everywhere in the United States.
- Let’s look at some numbers to see.

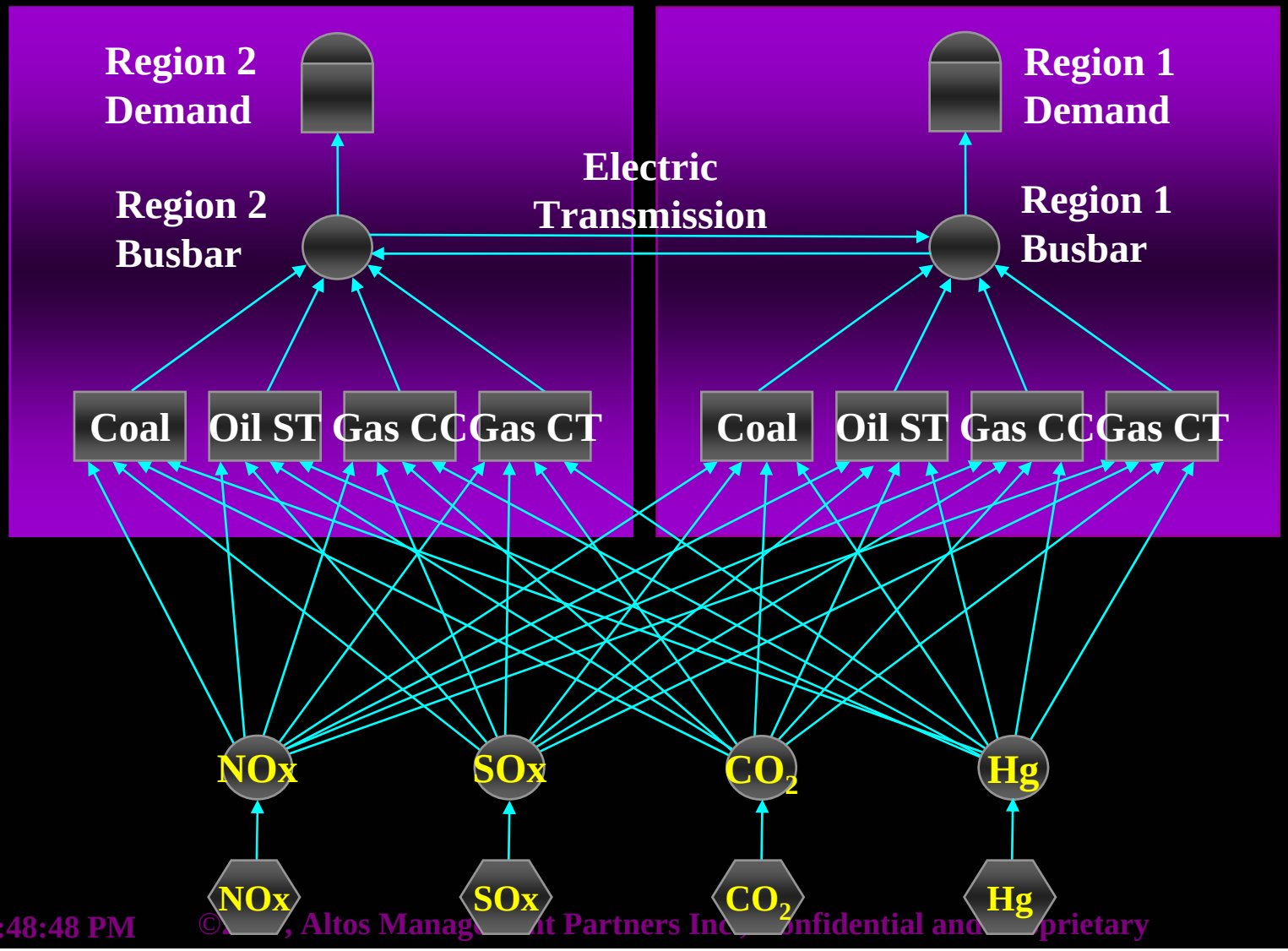
Coal and Gas Dispatch Cost With and without Environment



So How Do You Arrive at Correct Emissions Allowance (EA) Prices?

- EA scenarios are wrong on their face.
- Emissions allowance prices are endogenous, not exogenous, to the system.
  - ✓ One cannot guess them exogenously; they are endogenously related to relative fuel prices, retrofit marginal costs, and greenfield costs.
  - ✓ One cannot set up a range or a probability distribution because they are systematically related to and derived from fuel and power prices
  - ✓ If you change ANY price ANYwhere, they ALL change EVERYwhere
  - ✓ The intrinsic uncertainties are in other variables.
- One has to calculate them endogenously as a function of the announced caps

All Plants in the United States Have to Vie for a Fixed Supply of NOx, SOx, Hg, and Probably CO2 Emissions Allowances

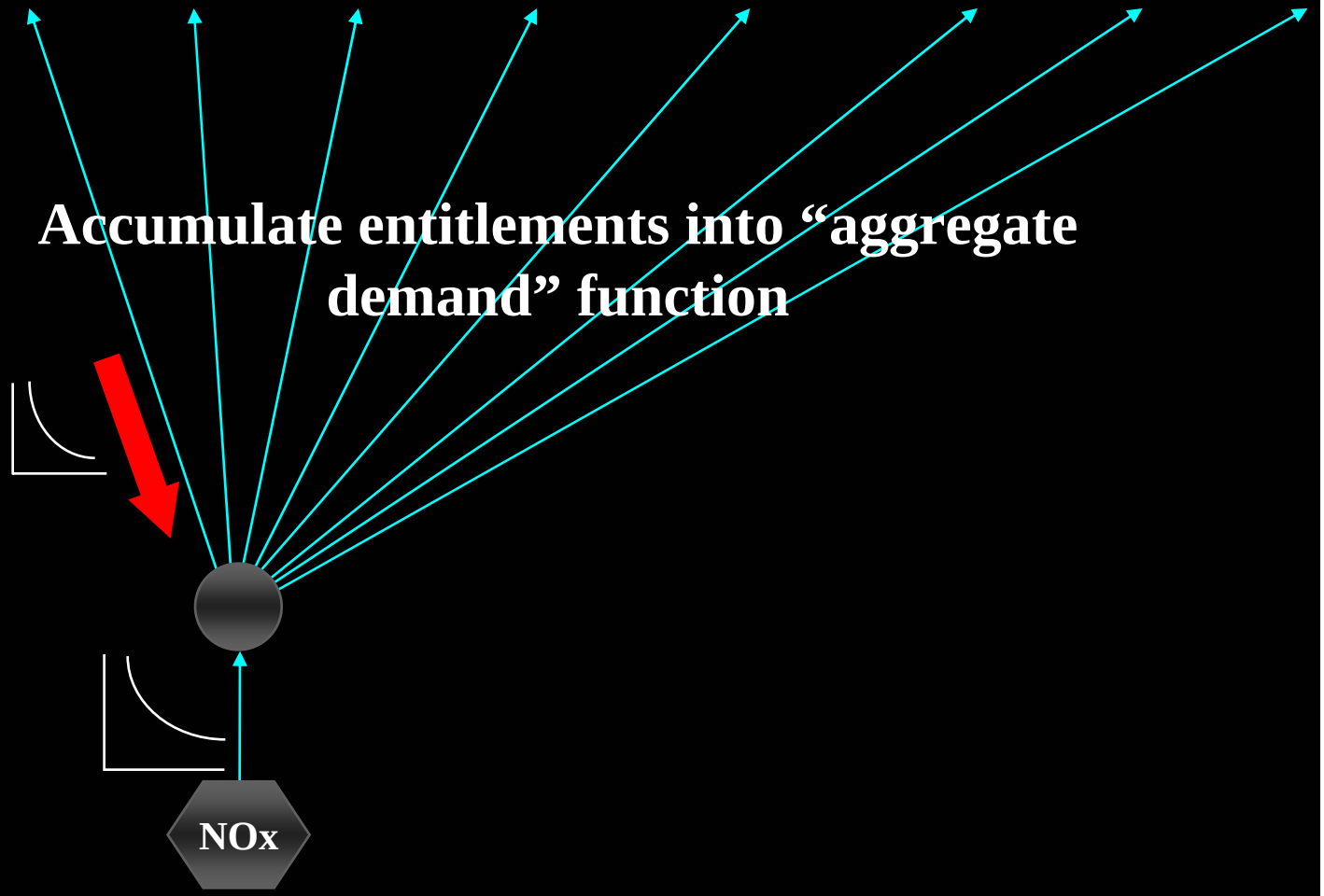


Plant Operations Accumulate Entitlements into Entitlement Demand Function

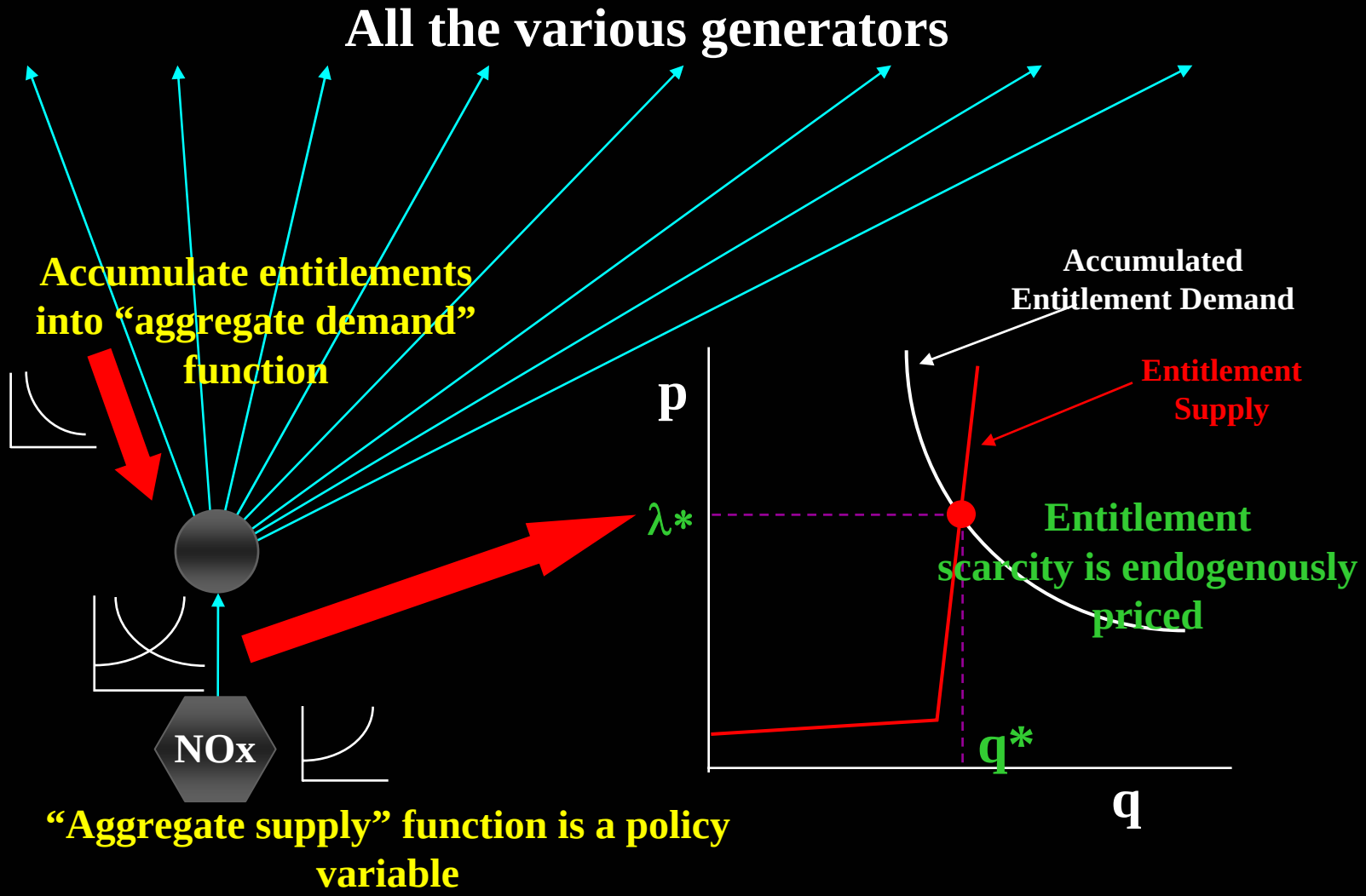
All the various generators

Accumulate entitlements into "aggregate demand" function

The 18,500 power plants in the United States constitute a "big old demand curve" for emissions allowances

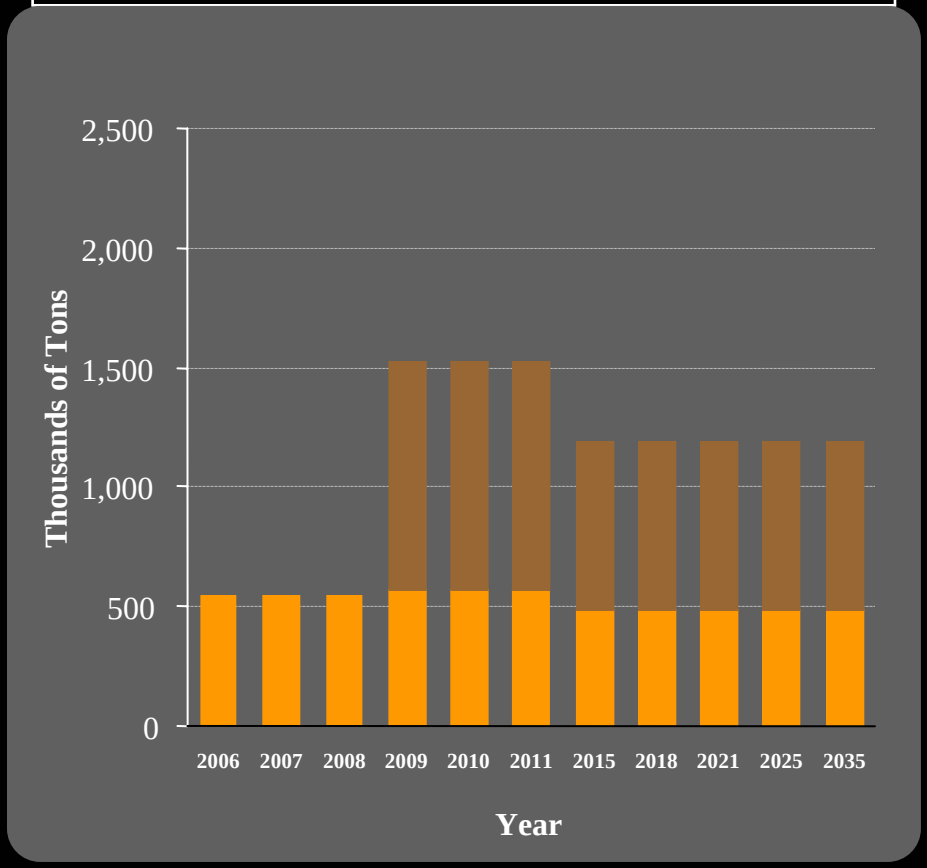


The EPA Sets the Aggregate Number of Allowances (Entitlements)

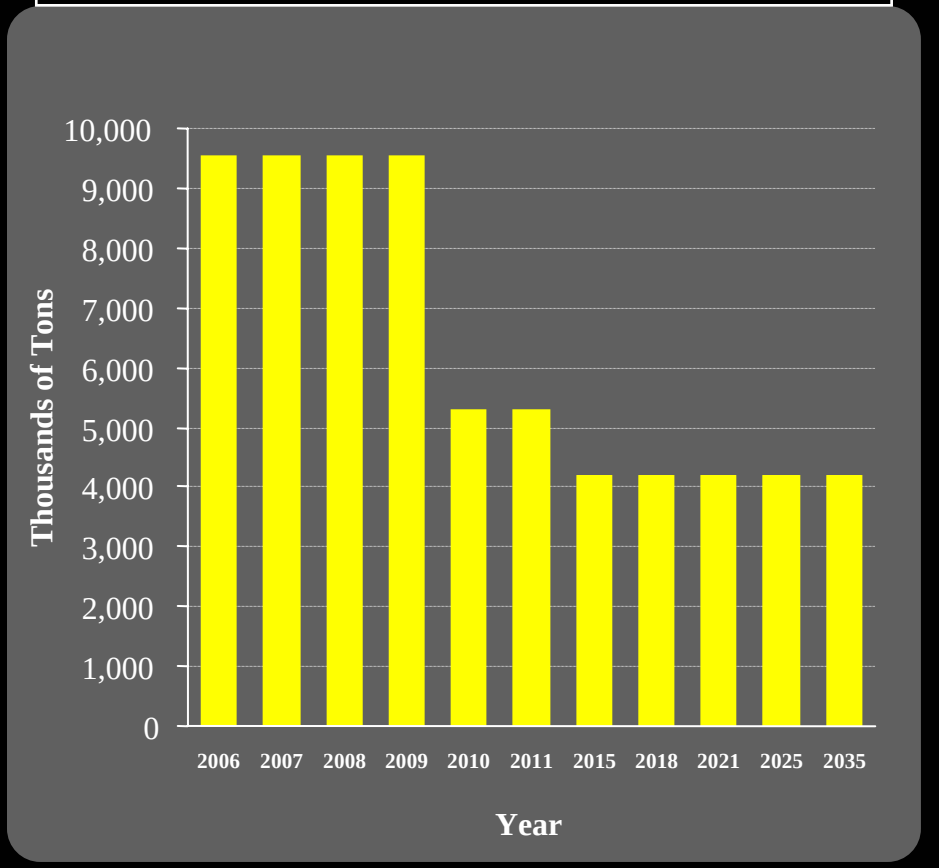


Base Case: CAIR Emission Cap (Already Enacted in Law)

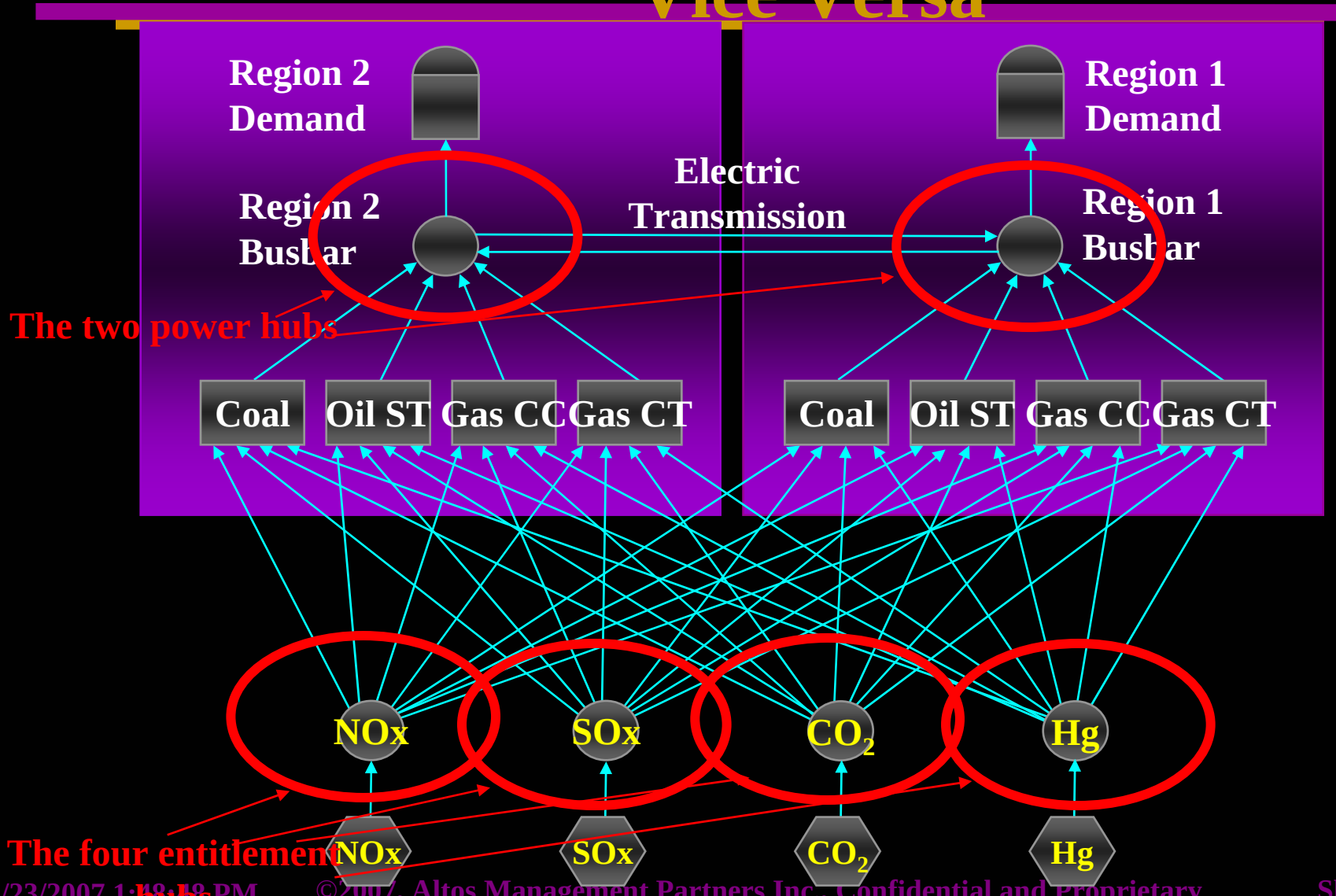
Maximum Allowable NOx Emissions (CAIR)



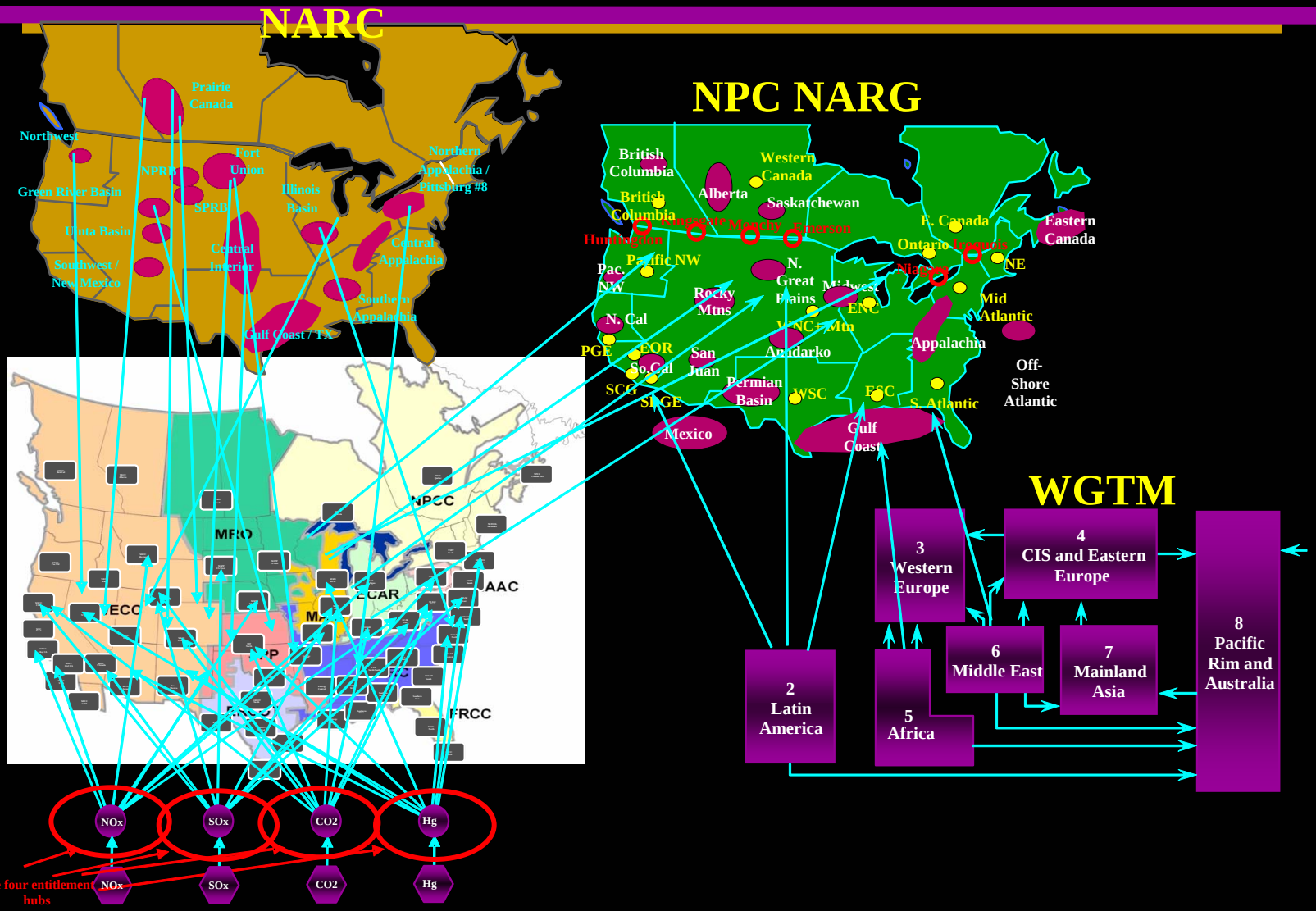
Maximum Allowable SO2 Emissions (CAIR)



Power Prices Depend on NOx, SO2, Hg, and Maybe CO2 Emissions Prices, and Vice Versa



For Our Demand Case Here, We Ran the Fully Integrated Model



NARE_Emissions

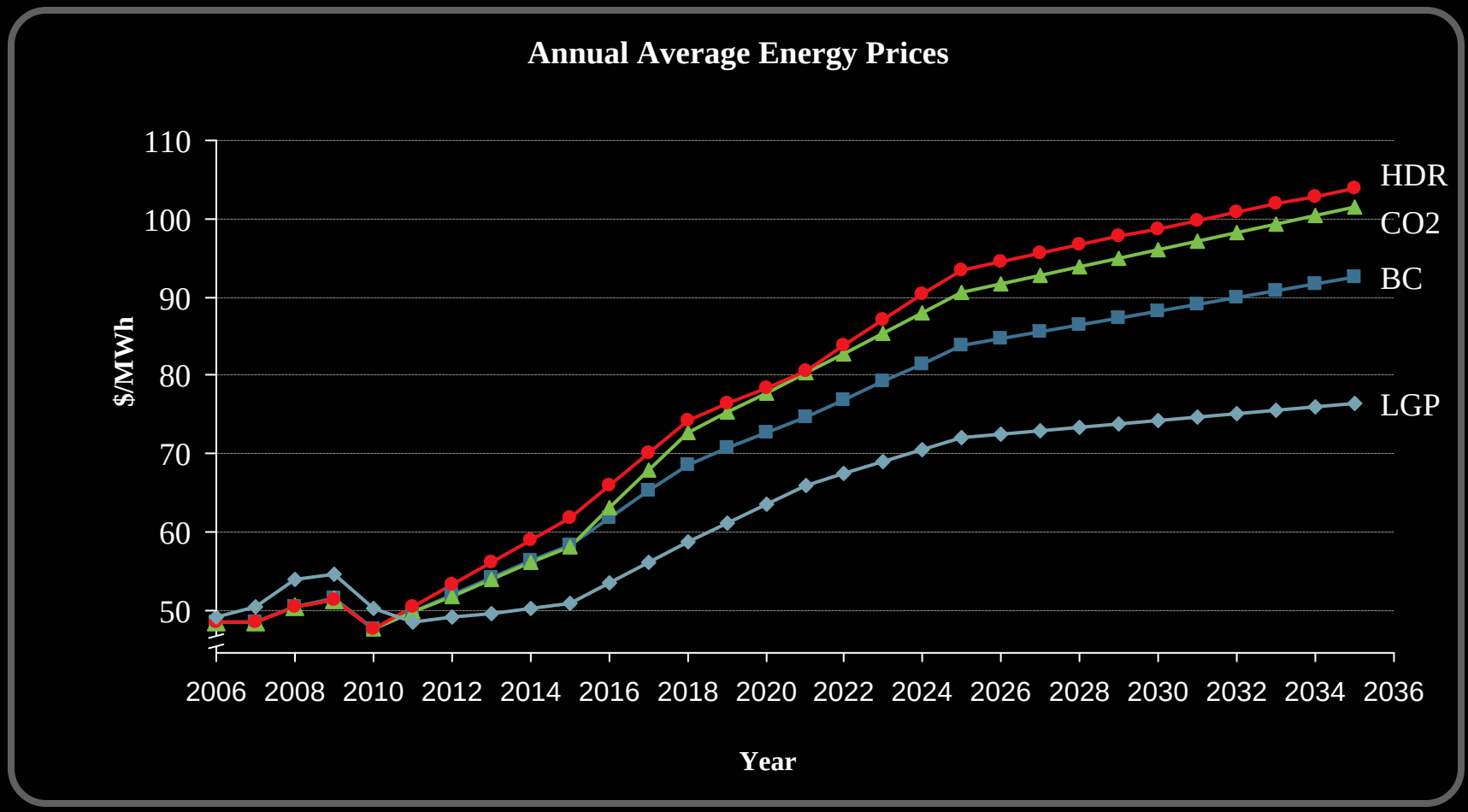
Realities of Oil

- Oil price is decoupled from gas price.
- There is virtually no residual oil produced in North America any more
  - ✓ There is no oil to substitute!
  - ✓ There are literally no substitutable applications anyway, because they cant get oil and because there isnt a lot of industry left.
- Models that correlate gas price with oil price are wrong.

Nine Scenarios Tell Us What the Environmental "Drivers" Are

No	Scenario Name
	Base Case
1	Low Gas Price
2a	Low Demand
2b	High Demand
3	High Discount Rate
4	High Gas Capital Cost
5	CAIR Plus and MACT
6	CO2 Cap
7	CONFIDENTIAL
8	Unlimited Nuclear Entry

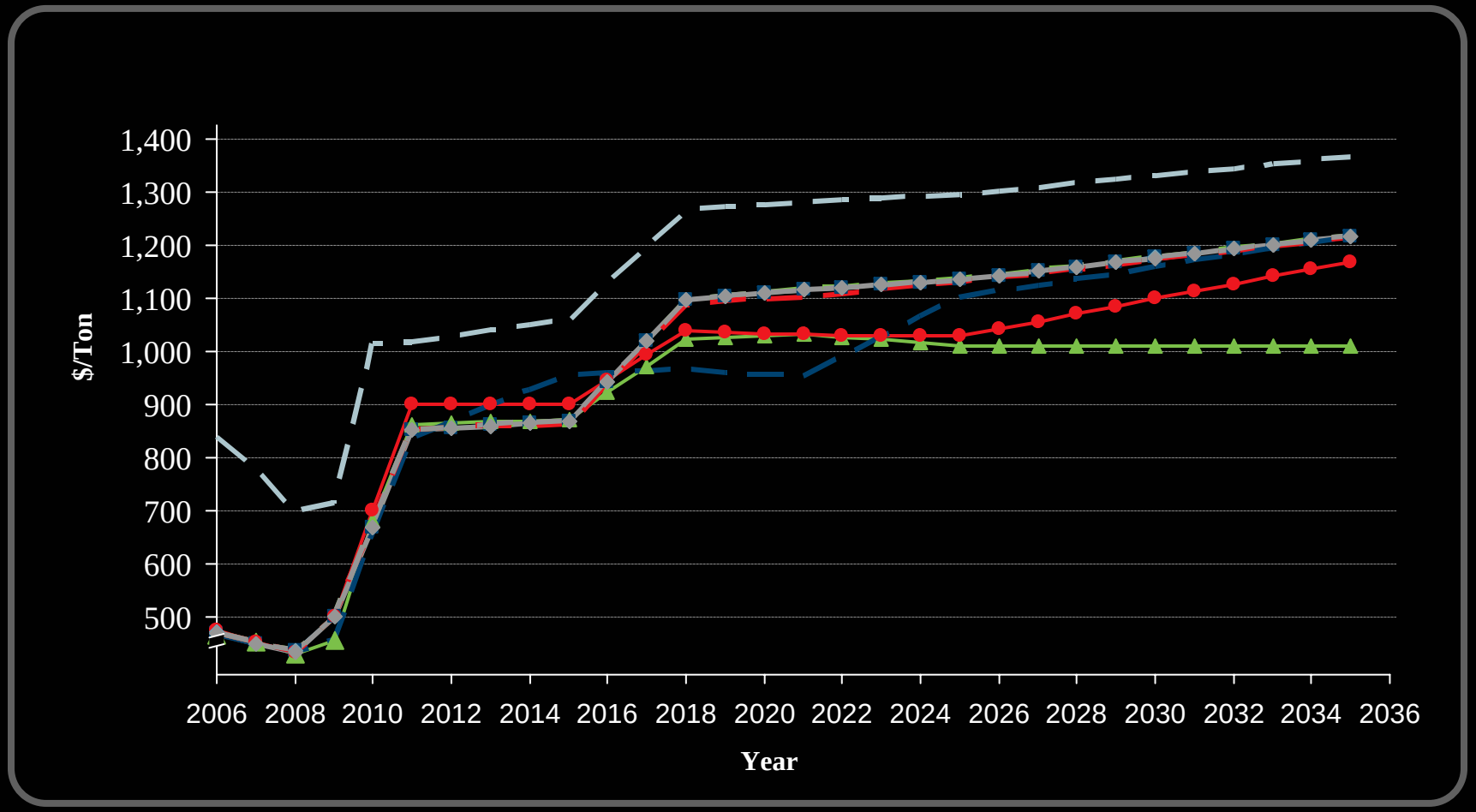
Power Prices Are Most Significantly Affected By High Discount Rate, CO2 Cap, and Gas Price



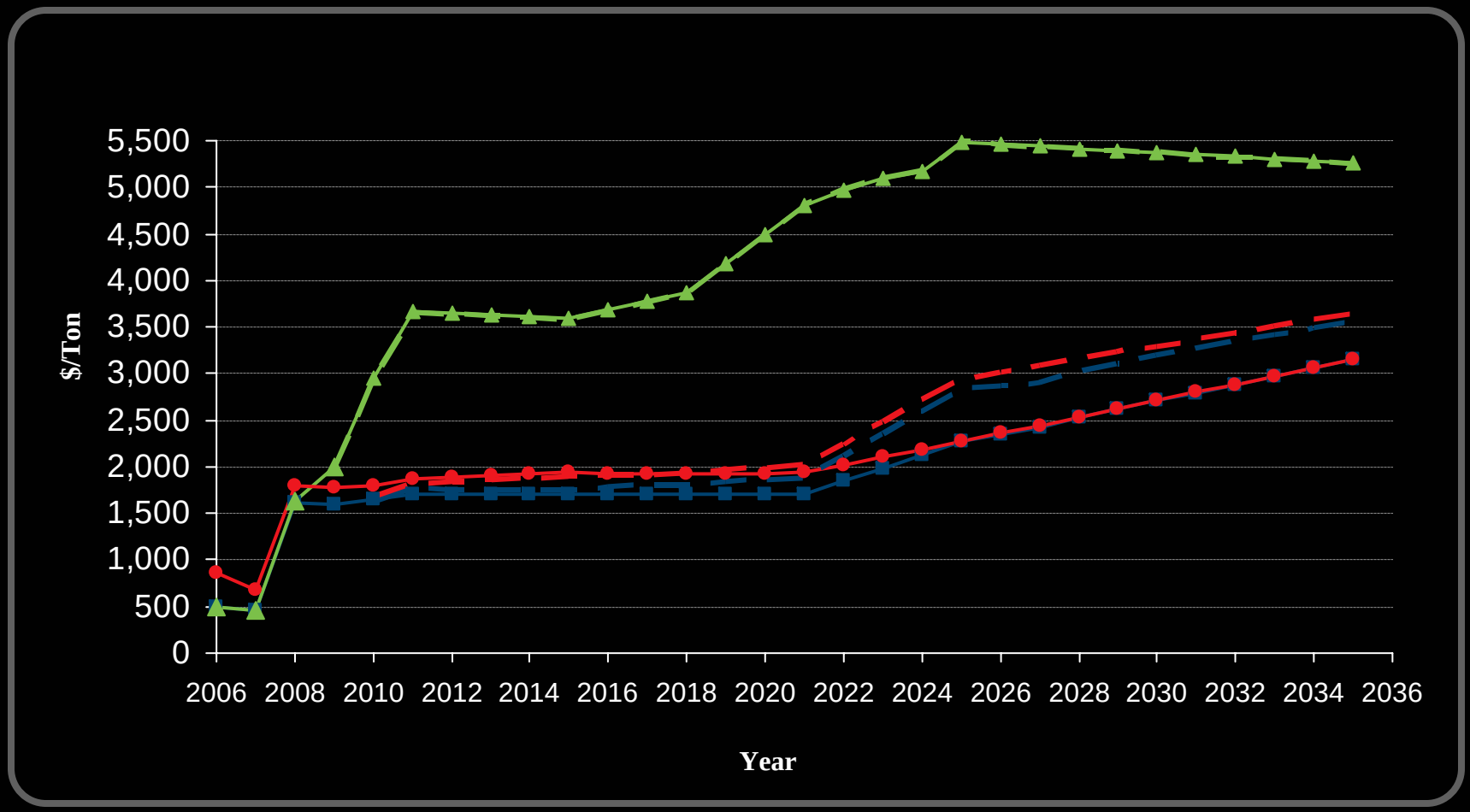
A Huge and Looming Issue Is Interest Rate

- Balance of payments deficit is colossal with no signs of abating.
- Government spending is colossal and out of control—federal, state, and local.
- The Fed HAS to raise real interest rates to the level of the 1980s, or the dollar will free fall in world markets.
- There are already signs; OPEC wants the Euro rather than the dollar. This is the 1970s again.

There Is Not A Huge Difference In SO2 Prices Amongst the Scenarios.

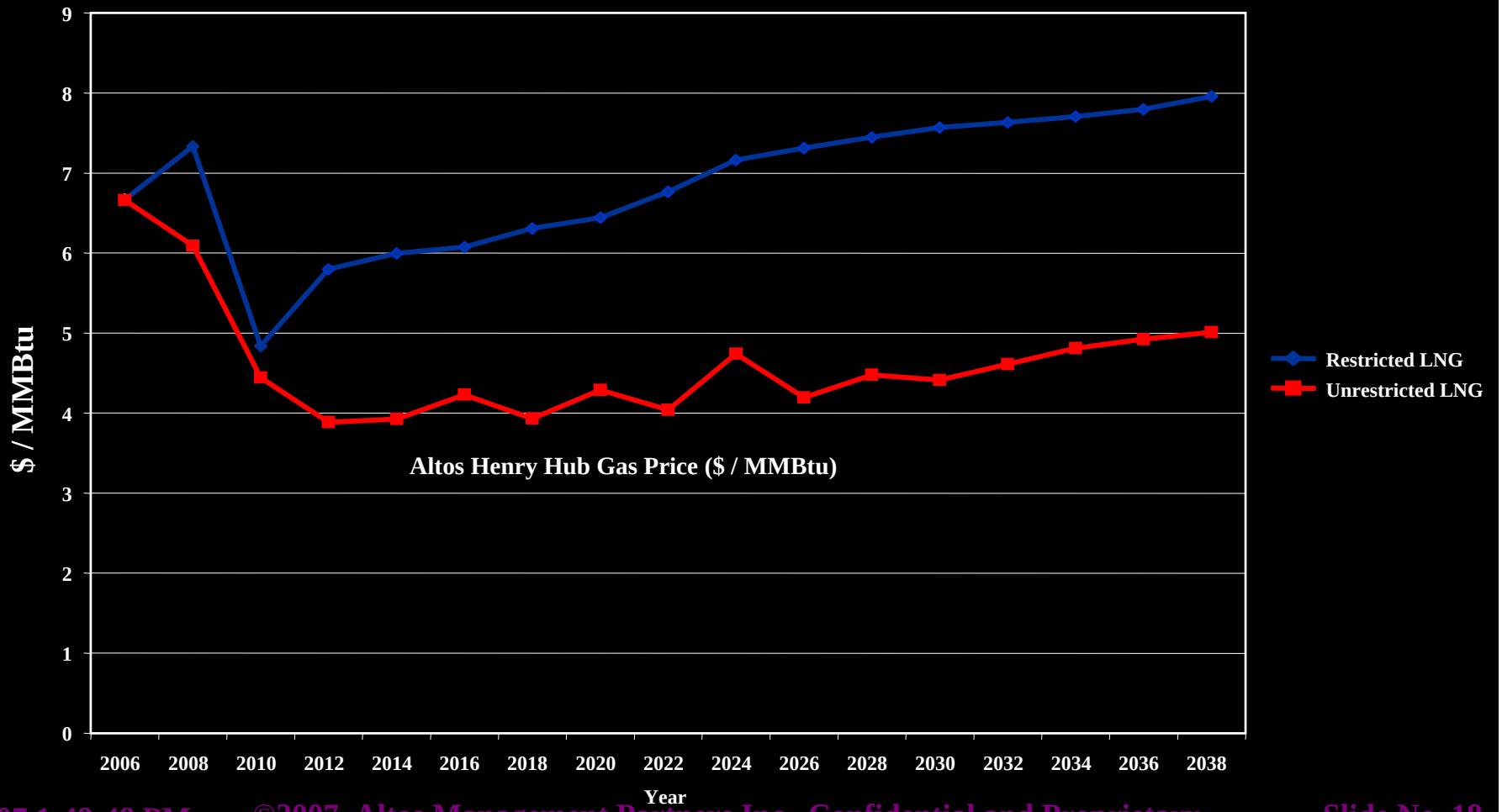


Tighter Emissions Constraints Considered Under CAIR+/MACT Have The Largest Effect On NOx Prices.



Low and Base Gas Price Scenarios

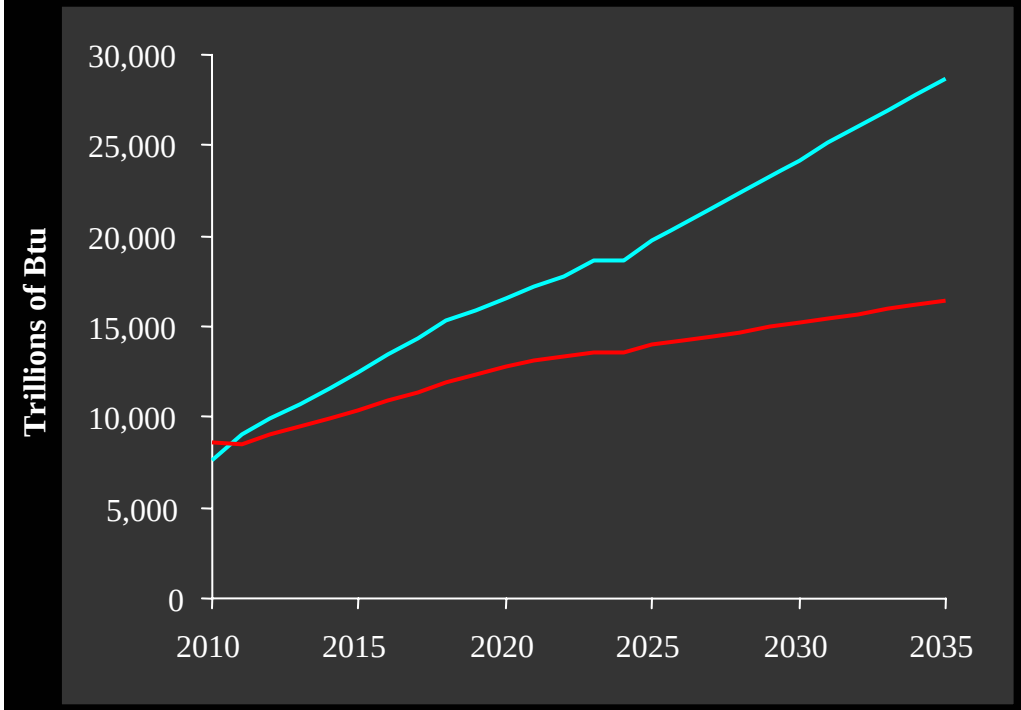
Low gas price scenario (Unlimited LNG) represents a completely unrestricted LNG entry scenario. Base case gas price (Restricted LNG) limits LNG entry to the most likely entrants.



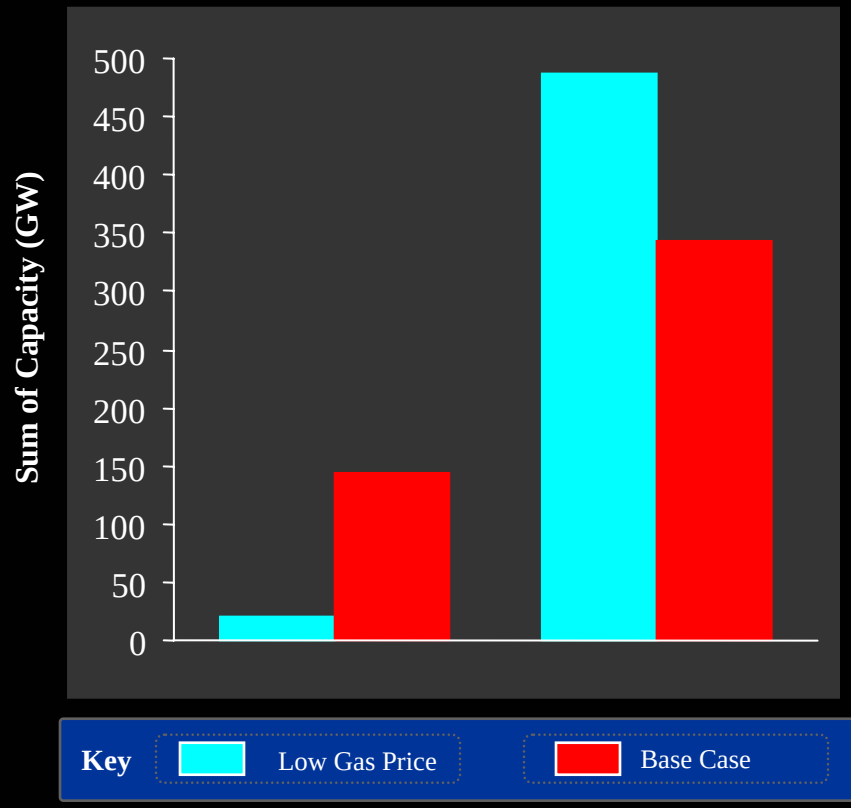
Low Versus High Gas Prices

Low gas price causes power prices as well as NOx and SO2 emission prices to drop relative to base case. It also stimulates strong entry of gas CC and CT and virtually eliminates coal plant entry.

Gas Burn



Greenfield Capacity Additions, 2006-35



What Do You Learn About Gas Burn from This?

- Gas burn ranges from high to extremely high no matter what the gas price.
- Higher gas price leads to higher emissions allowance prices (we have seen that historically; they are down right now because gas prices are off)
- If the EA prices don't rise to close the fuel price gap, we don't meet the cap.
- EA prices, particularly carbon, have to get to very high levels to meet announced caps.
- EA's arent monopoly money; this isnt a parlor game. These are real dollars.

High Renewables Case

- Renewables are intrinsically intermittent.
- That requires backup for public safety and peak price moderation and other reasons.
- Backup wont be coal because coal cannot afford the EAs
- Backup wont be nuclear because many states (e.g., CA) have antinuclear laws and because economic risks are colossal.
- Backup wont be renewables because system reliability and public safety require lower LOLP

High Renewables Case

- **High renewables case are high, not low, gas burn cases.**
- **ALL THE CASES THE CEC HAS RUN THUS FAR ARE "HIGH COAL" CASES BECAUSE THEY ARE "LOW GAS" CASES.**
- **These are not the cases you really wanted to run I would conjecture.**
  - ✓ **It is NOT renewables versus gas.**
  - ✓ **It is renewables backed by gas versus coal.**
  - ✓ **High renewables cases should be low coal and therefore high gas cases.**